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(54) Composite sheet stock for microwave heating and receptacle.

(57) A composite sheet stock for microwave heating comprises a susceptor sheet (30) having a dielectric support layer (36), a heater layer (34) of microwave interactive material and a heat-conducting microwave reflecting layer (130). A receptacle with a self-supporting configuration for combined microwave baking and cooking of a food article, such as pizza, is constructed from susceptor stock and comprises an outwardly exposed, dielectric support layer, such as paperboard, and an inwardly facing heater layer and includes a lower flat portion for supporting the food article during heating. The lower portion may be a layer of composite stock as above or it may be formed from at least two layers of susceptor stock without a heat-conducting layer. The lower portion of the food product is, thus, heated primarily by conduction, while the upper portion is heated by combined radiation from the susceptor sheet and absorption of microwaves passing through the susceptor sheet. The receptacle may be collapsible.

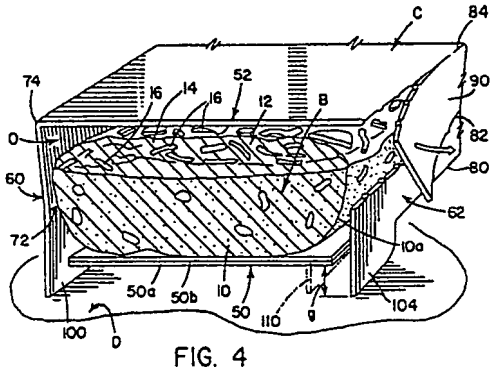

FIG. 4

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Composite sheet stock for microwave heating and receptacle

This invention relates to the microwave heating of food products and more particularly to a sheet stock and a microwave heating receptacle, and a method of using this receptacle for reconstituting frozen food products. Throughout the present specification the expression "reconstituting" is used to mean "preparing for consumption".

The present invention is particularly applicable for reconstituting frozen pizza, such as elongated, rectangular sections of bread topped with pizza constituents and frozen individually. The invention will be described with particular reference to this food product; however, it is appreciated that the invention has substantially broader applications and may be used for heating or reconstituting various food products of the type having a lower, generally flat, farinaceous portion which is to be heated to a crisp condition preparatory to serving.

Various approaches have been suggested to the microwave reconstitution of frozen pizza, involving special packages. For example, US Patent 4190757 shows a lower susceptor sheet spaced from the bottom wall of the microwave oven onto which the lower farinaceous crust portion of the pizza is supported so that the crust portion was heated to a high temperature causing browning and crispness adjacent the lower surface of the crust. This procedure, although having some advantages, was not successful until the development of the susceptor material disclosed generally in US Patent 4641005. Such material was used to construct the plates, boats and/or platforms suggested for reconstitution of frozen pizza. By using this new sheet susceptor material, some crispness is obtained at the lower level of the pizza crust; however, the crust remained flaccid and the sauce, forming a constituent of the topping, was overcooked. The remainder of the crust layer was heated in a non-uniform manner to result in a soft crust. Frozen pizza reconstituted by microwave procedures employing a microwave susceptor sheet of the general type disclosed in US Patent No. 4641005 is still substantially unacceptable for quality reconstitution of frozen pizza of the type using standard crust. When using a bread base for the pizza, the bread was flaccid. The lower surface of the crust, in both instances, became brown or crisp; however, the rest of the crust was still extremely crunchy. Thus, even use of the new microwave susceptor sheet material had the disadvantages of prior attempts to reconstitute pizza using standard unbaked crust or a bread base in a microwave oven.

According to one aspect of the invention, there is provided a composite sheet stock comprising a microwave susceptor sheet having a dielectric support layer and a heater layer of microwave interactive material allowing passage of microwave energy as it is heated thereby, and a layer of heat-conducting, microwave reflecting material adhered to the heater layer.

In accordance with a another aspect of the present invention, there is provided a receptacle in the form of a self-supporting box or sleeve formed from a highly metallized microwave susceptor sheet stock so that the sheet stock has a lower flat portion and an upper flat portion to completely surround the flat pizza to be heated in a microwave oven. When in its operative assembled condition, the box or sleeve has generally fixed configurations with a height substantially greater than the thickness of the pizza for which the box or sleeve forms a heating receptacle. This concept uses a susceptor of a generally rigid sheet stock, such as paperboard, which can be bent into a shape that is maintained by the rigidity of the support board. This is different from a wrapping stock wherein the shape is dictated generally by the shape of the product.

The base of the receptacle may be formed from the composite sheet stock in accordance with the invention, with the dielectric layer facing outwardly. Alternatively, the lower portion or base may be made of at least two susceptor layers wherein one of the susceptors may be formed integral with the box or sleeve and the second may be a separate element,optionally secured to the first. In addition, the surface resistivity of the second susceptor layer may be different from the surface resistivity of the first susceptor layer. The upper portion of the food article is heated by a combination of radiation from the surrounding susceptor sheet and microwave energy that passes through the susceptor sheet. In the lower portion of the sleeve, the second sheet causes nearly all of the microwave energy to be absorbed so that a substantially greater amount of heat is generated for baking and crisping the crust. The second layer of susceptor material may also extend to areas beyond just the bottom portion for changing the heating characteristics of the sleeve or box. When the bread crust extends upwardly along the edges of the pizza base, the second layer of susceptor material may extend upwardly along the side walls of the sleeve.

The lower portion of the sleeve or box is flat and is desirably elevated a preselected distance from the bottom wall of the microwave oven. The heat absorbed in the first layer of microwave susceptor material is transferred by convection to the second layer of susceptor material. This second layer is also heated by microwave energy and

transmits the heat from the first layer and its own heat to the bottom surface of the food article resting upon the two layers of susceptor sheet material. This second susceptor layer or sheet material may be glued or laminated to the first layer in the bottom portion of the box or sleeve or it may bean integral part of the blank which forms the box or sleeve.

In accordance with another aspect of the invention, a highly heat conductive layer, such as aluminum foil, may be located between the two microwave susceptor layers. This assists in the transfer by conduction of heat from the lower susceptor sheet to the upper susceptor sheet. When this occurs, the upper susceptor sheet is heated by microwave energy coming through the product itself to create a second heat source in the lower portion of the box or sleeve. In this embodiment, the lower portion of the receptacle may be formed from a layer of the composite stock described above and a susceptor layer.

In accordance with another aspect of the invention, the feature of increasing the heating effect whilst decreasing the amount of microwave energy passing through the bottom of the receptacle, may be accomplished by selectively increasing the amount of metal in the metallized heating layer of the susceptor sheet in the bottom or lower portion of the receptacle.

In accordance with another aspect of the invention, the receptacle is a sleeve which has side walls that are collapsible so that the sleeve can be flattened and shipped in a position adjacent, preferably under, the pizza segment(s). When a pizza segment is to be reconstituted, the flattened sleeve is expanded and used as a self-supporting receptacle for a single pizza segment. This manipulating action may also extend a set of integral legs cut from the rigid paperboard which serve to create the necessary spacing between the bottom wall of the microwave oven and the lower flat portion of the receptacle. The height of the sleeve is preferably greater than the thickness of the pizza segment; however, the width of the sleeve is not substantially greater than the width of the segment, so that there is a space above the pizza, which should not be more than about 25 mm and is preferably less than about 13 mm.

Brief description of the drawings

FIGURE 1 is a partially cross-sectioned, pictorial view of a packaged pizza segment containing a folded receptacle constructed in accordance with the preferred embodiment of the present invention;

FIGURE 2 is a partial, pictorial view of the preferred embodiment of the present invention in the collapsed, shipping configuration, as shown in FIGURE 1, and further showing an enlarged partial view illustrating features of the sheet stock of the preferred embodiment of the present invention;

FIGURE 3 is a view similar to FIGURE 2 showing the preferred embodiment of the present invention in the manually assembled, free standing heating configuration, together with a modification of the invention shown in phantom lines;

FIGURE 4 is a view similar to FIGURE 3 with the pizza inserted into a sleeve constructed in accordance with the preferred embodiment of the present invention and illustrating a tear strip feature of the invention, together with the modification of the preferred embodiment again shown in phantom lines;

FIGURE 5 is a construction layout of the sheet stock blank as it is cut and serrated for assembly into the shape illustrated in FIGURES 1-4;

FIGURE 6 is a side elevational view showing operating characteristics of the preferred embodiment of the present invention with the modification again shown in phantom lines;

FIGURE 7A is an enlarged section illustrating the circular portion 7A of FIGURE 6;

FIGURE 7B is an enlarged section illustrating the circular portion 7B of FIGURE 6;

FIGURE 8 is an enlarged, cross-sectional view of the lower portion of the receptacle constructed in accordance with the invention and illustrating a slight modification of the preferred embodiment of the invention;

FIGURES 9-12 are enlarged, cross-sectional views taken generally along the lower portion of the receptacle constructed in accordance with the present invention and illustrating modifications which can be accomplished in the lower portion in accordance with aspects of the present invention;

FIGURE 13 is a time power graph illustrating the heating cycles employed in the preferred method utilizing the disposable, self-supporting receptacle illustrated in FIGURES 1-12;

FIGURE 14 is a modification of the preferred embodiment wherein the sleeve illustrated in FIGURES 1-4 is an encircling box formed from microwave susceptor sheet stock;

FIGURE 15 is a multiple plane cross-sectioned view illustrating various structural features of the modification of the invention shown in FIGURE 14, together with an enlarged section illustrating the cross-section of the lower flat wall portion in this modification;

FIGURE 16 is a partial pictorial view, in cross-section, illustrating the operating configuration of the modification of the invention shown in FIGURES 14 and 15; and,

FIGURE 17 is a blank cut from a paperboard

support stock and including microwave interactive material which can be employed in the modification of the invention shown in FIGURES 14 and 15 and including certain modifications which are applicable to various disposable receptacles constructed in accordance with the present invention.

Referring now to the drawings, illustrating the preferred embodiments of the invention, FIGURES 1-4 show a package A for shipping and distributing a frozen entree B such as a flat, elongated rectangular segment of pizza formed by placing on the upper surface of a bread layer 10 having a generally cup-shaped crust 10a, a topping layer 12 formed from sauce 14 and miscellaneous food items 16. The bread is baked, sliced and cut to size. Thereafter items 16 in a frozen condition and sauce 14 are spread on the upper surface of the bread. Package A is formed of paperboard and includes an outer shipping carton 20 of the type which is not microwave compatible and is selected for shipment purposes only. Food article B is wrapped in an air impermeable, plastic wrapper 22 which may be evacuated or filled with an inert gas. Article B is frozen and shipped in carton 20 for display in the freezer section of a retail outlet. Within carton 20 there is provided a disposable heating or reconstitution receptacle in the preferred form of sleeve C formed from the sheet paperboard blank, such as illustrated in FIGURE 5. Sleeve C is formed from a microwave susceptor sheet 30 of the type disclosed in US Patent 4641005. This susceptor sheet includes a layer of generally continuous microwave interactive material 32 formed by vacuum depositing a thin layer of aluminum or similar metal onto a smooth plastic support film 34 which is, in turn, adhered to a flat, generally rigid paperboard 36 forming the support layer for microwave susceptor sheet 30. By changing the surface resistivity of microwave interactive material 32 through changing the thickness of this layer, the amount of heating caused at the layer of interactive material 32 can be modulated. In accordance with the preferred embodiment of the invention, the interactive material is of the type having a surface resistivity less than about 6 ohms/cm, preferably about 5 to 6 ohms/cm, and is constructed upon a standard weight paperboard and is as rigid as a standard poster stock. Such microwave susceptor sheet stock material, but with a higher resistivity, is well known in the art and is widely used for microwave heating of various food products. The selection of a low surface resistivity on a firm or generally rigid paperboard for an encircling free standing sleeve C is believed to be novel. This combination of strength and high heating by low resistivity is a further advantage of the preferred embodiment of the present invention.

Referring now more particularly to sleeve C, this sleeve includes two parallel, generally flat portions 50, 52 which are adapted to be located on opposite sides of the food item B during the microwave heating operation. In accordance with the present invention, lower or bottom flat portion 50 is formed from two separate layers 50a, 50b of microwave susceptor sheet 30. Consequently, sleeve C comprises parallel flat portions 50, 52 with lower or bottom portion 50 formed by two separate and distinct interactive layers 50a, 50b. To interconnect parallel, flat portions 50, 52, sleeve C includes integral side walls 60, 62. Wall 60 includes parallel cut lines or serrated seams 70, 72, and 74. In a like manner, wall 62 includes cut lines or serrated seams 80, 82, and 84. By incorporating these seams sleeve C can be folded into a collapsed condition, as shown in FIGURE 1 or can be manually expanded into the operative, heating configuration, as shown in FIGURES 3 and 4. To allow easy removal of the heated pizza segment or food item B, after the microwave reconstitution, seams 82, 84 are formed into parallel tear lines so that tear strip 90 can be manually removed from side wall 62. This opening feature allows easy removal of the heated food article and assures that sleeve C is discarded since it is generally of no use after tear strip 90 has been removed.

To assure that microwave energy enters through lower portion 50, to heat susceptor layers 50a, 50b, lower portion 50 must be spaced from the lower wall D of the microwave oven during the heating process. This spacing can be maintained by a separate element as shown in FIGURE 14 or, as in accordance with the preferred embodiment, by a plurality of integrally formed downwardly depending legs 100, 102, 104 and 106 which are folded into a generally flat condition when sleeve C is collapsed, as shown in FIGURES 1 and 2, and are moved to downwardly depending positions, as shown in FIGURES 3 and 4, when sleeve C is manually formed into its heating or operative configuration. These legs are cut from microwave susceptor sheet 30, as best illustrated in FIGURE 5.

Sleeve C is self-supporting and has the features discussed in the introductory portion of this disclosure. It is collapsed or folded and shipped in a generally flat condition in package A, as shown in FIGURE 1 and FIGURE 2. When article B is to be reconstituted, it is removed from wrapper 22, the sleeve is manually assembled into the configuration shown in FIGURE 3 and the article is slipped longitudinally into the sleeve, as shown in FIGURE 4. Side walls 60, 62 extend upwardly along the vertical portion of crust 10a. Sleeve C loaded with article B is positioned on lower wall D of the microwave oven and the oven is energized to cook, bake or otherwise reconstitute the frozen food en-

tree or food article B.

In FIGURES 6, 7A and 7B, the operating characteristics of the preferred embodiment of the present invention, as shown in FIGURES 1-5, are illustrated graphically and in a general manner. As shown in FIGURE 6, microwave energy, indicated as W, penetrates through upper sleeve portion 52. During this penetration, a certain amount of energy is consumed to heat the layer 32. Thus, the inner chamber O of self-supporting receptacle C is a small oven chamber wherein heat is radiated from that portion of the susceptor sheet 30 forming upper portion 52. A substantial amount of the microwave energy passes through material 30 and heats the topping 12 which is lossy material whilst portion 52 radiates heat to the topping surface. Combined radiation and microwave absorption, together with slight convection, causes oven chamber 0 to heat the topping efficiently, but at a lower temperature level than needed to heat bread 10 and make crust 10a crisp. By providing a double layer of susceptor sheet 30 as the bottom flat portion 50 of sleeve C, as shown in FIGURE 7B, the same type of strong microwave heating of bread layer 10 is avoided. As the microwave energy (W) is reflected upwardly toward the vertically elevated, lower flat portion 50, it passes through the two sheets and is reduced in intensity as represented by arrows W3. To show this feature energy W enters paperboard 36 as W1. There is no appreciable energy absorption by the layer 36, which is microwave transparent. The microwaves then pass through the first interactive layer 32 which removes a substantial amount of energy from W1. The amount of absorption is controlled by the amount of metal in layer 32 which is expressed as surface resistivity (R_s). This energy absorption by layer 32 of layer 50a produces weaker microwave energy illustrated schematically as W2 shown progressing upwardly through the second layer 50a where it interacts with microwave interactive layer 32 of layer 50b which converts even more of the original microwave energy into heat. Only a minor portion, if any, of the original microwave radiation W passes through second layer 50a. Thus, the layer 50b is heated by microwave lower interactive layer 32, and heat is convected from this first layer as indicated by the serpentine lines CV upwardly through the layer 50b. This convection heat combines with the further heat generated at the second interactive layer 32 to convert a major portion of the incoming microwave energy into convected heat as indicated by further lines CV above layer 50b. Board 36 of lower layer 50a insulates sleeve C so that the convective energy moves generally upwardly through the upper portion of layer 50b to combine with the heat generated in this layer. There is, thus, a high heat concentration at lower crust 10a. To enhance this operation, the second layer could be provided in the vertical areas of crust 10a adjacent side walls 60, 62. As indicated in FIGURE 7A, the heating effect is caused by induced flow of current I when microwaves W pass through an interactive layer 32 of susceptor sheet 30; therefore, penetration by radiation is generally required for the purpose of causing heating of the interactive material. To provide reflected radiation, sleeve portion 50 is spaced a distance g from lower wall D. This spacing is in the range of 3 to 13 mm and can be provided by legs 100, 102, 104 and 106, as previously described, or by a separate spacer element, such as the corrugated board shown generally in FIGURE 16.

The novel sleeve is a receptacle for heating the article, as opposed to some type of general heat conducting material wrapped around the article and having a shape determined by the article. To add rigidity to this particular construction, the lower layer 50a can be provided with a downwardly and transversely extending rib 110, shown in phantom lines in FIGURES 2-4. This rib allows use of a thinner paperboard while maintaining the necessary gap g under lower portion 50. Of course, other downwardly depending tabs and ribs could be provided for further enhancing the rigidity of lower portion 50 to prevent undue sagging of this lower support portion of sleeve C.

FIGURE 8 shows that the surface resistivity of layer 50a can be different from the surface resistivity of layer 50b. This objective can be accomplished by a separate microwave susceptor sheet forming layer 50b or the layer 50b can be provided with a different thickness of metal constituting interactive material or layer 32 of sheet 30. The higher surface resistivity of lower layer 50a indicates a thinner layer of resistive metal in layer 32 and a correspondingly lesser heating effect at layer 50a. Thus, most heating occurs in layer 50b in this particular modification of the present invention. Consequently, conduction from lower layer 50a is not as important a component of the total heating effect as when both layers are formed from the same microwave interactive material or sheet 30.

In FIGURE 9, a third layer 50c of microwave interactive material is incorporated in the lower flat bottom portion 120 of a modified sleeve. This separate sheet stock of interactive material can have a distinct surface resistivity. As can be seen, the microwave energy is captured at least by the third interactive layer 50c so that only a negligible amount of microwave energy enters into layer 10 from lower flat portion 120. In these instances, the paperboard support layers 36 of layers 50a, 50b, 50c can be relatively thin since overall support for the product being heated is obtained by the lower layer 50a and at least by lower layer 50a in com-

bination with upper layer 50b. In accordance with another aspect of the invention, the support paperboard or other dielectric material 36 for each layer (50b, 50c) above the bottom structural support layer 50a is relatively thin and may be substantially greater than 16 points.

FIGURE 10 shows the composite stock wherein the lower susceptor layer 50a is covered by a heat conduction layer 130 so that heat generated in lower surface 50a is conducted through this heat conductive layer 130 into layer 10 to cause high heat at crust 10a. In the preferred embodiment of this aspect, this conductive layer 130 is aluminum foil that reflects microwave energy. Thus, microwave energy passing through reactive layer 32 of lower layer 50a causes heating as the microwaves pass toward and away from the reflective layer 130. This dual action enhances the heating effect of lower layer 50a, which, in turn, causes the temperature at surface 130 to be relatively high. Further, the reflective nature of metal layer 130 shields crust 10a against microwaves from lower portion 50 of sleeve C. Thus, all heat at the surface of crust 10a is by conduction from heated layer 130.

A further modification of the concept shown in FIGURE 10 is shown in FIGURE 11 wherein the heat conduction layer 130 is located between lower layers 50a, 50b. In this construction, microwave energy which happens to pass downwardly through topping 12 and bread layer 10 is converted into heat by the uppermost layer 50b of lower portion 50. A modification of this concept is illustrated in FIGURE 12 wherein layer 50b′ is similar to layer 50b except that the order of lamination is reversed. The interactive material 32 of layer 50b′ is adjacent aluminum foil 130.

In accordance with the cooking method aspect of the invention, the heating cycle for reconstitution of pizza with sleeve C is shown, by way of example, in FIGURE 13. The microwave oven is first energized with a power setting of between 25%-50% for approximately 6.0 minutes. This method has been found to be sufficient to reconstitute pizza segments sold by Stouffer Foods Corporation under the designation "French Bread Pizza". Should the microwave oven have a low power rating, i.e. in the range of 400-600 watts, then the power setting should be at the higher level, such as approximately 50%. Using a microwave oven having a higher power rating of 600-800 watts, the setting may be reduced to approximately 25% for about 6.0 minutes. The initial heating, which causes the starch of the bread layer 10 to swell before water within the starch begins to heat, is followed by heating for approximately 1.0 minute at full power. This allows the microwave energy to fully cook the topping portion of the pizza.

A modification of the preferred embodiment of the invention is illustrated in FIGURES 14-17 wherein the free standing receptacle of the present invention is in the structural form of a box 200 assembled from blank 202 of 16 point, generally self-sustaining paperboard and containing, at least, areas of microwave interactive material. Thus, the sheet stock of blank 202 is a microwave susceptor sheet similar to sheet 30 of sleeve C. Blank 202 is illustrated in detail in FIGURE 17 and has a shape to be assembled into a structural configuration which will encircle the pizza segment or other food article B shipped in a wrapper 22 in package A, as shown in FIGURE 14. In this embodiment, the pizza segment is shown as being actually shipped in heating receptacle box 200 with a first spacing member 210 under the box. Member 210 has a thickness generally corresponding to the desired spacing g. Box 200 includes a separate, second microwave susceptor sheet 212 so that the lower flat portion 220 of the box is provided with two susceptor sheets for the reasons explained in connection with the preferred sleeve configuration. In the box concept, the upper portion of the encircling microwave susceptor sheet is a self-supporting, flat lid 222 joined with lower flat portion 220 by free standing side walls 224, 226 obtained by folding blank 202 along cut lines or seams 230, 232, 234, as best shown in FIGURE 17. To facilitate folding of tabs 240 there are provided cut lines or seams 241 so that tabs 240 can be interlocked with end flaps 250 defined by parallel cut lines or seams 242, 244.

Box 200 can be shipped in package A in a flattened condition or assembled around the pizza, as shown in FIGURE 14. To assemble the box before or after shipping, end flaps 250 are folded upwardly and interlocked with tabs 240. After the sheet insert 212 has been placed along bottom portion 220, pizza B is placed within the box. Wrapper 22 is removed before actually heating the pizza. As shown in FIGURE 16, spacer member 210 is placed under lower flat portion 220 to raise the box a distance g from lower oven wall D for the purposes of heating in accordance with the method described generally in conjunction with the schematic heating cycle shown in FIGURE 13.

Blank 202 can be provided with selective areas of different microwave interactive materials. To illustrate this concept, the surface resistivity of the various panels in blank 202 is shown as having a value a, b, or c. In the illustrated embodiment, the bottom portion 220 has a low surface resistivity which indicates a greater amount of metallization. Consequently, this surface will heat to a greater extent than the side walls and lid which have a higher surface resistivity and, thus, a lower metallization. End tabs 240 and end flaps 250 are not metallized at all, being merely self-sustaining pa-

perboard. In this manner, microwave energy can enter each end of box 200.

Claims

1. A composite sheet stock comprising a microwave susceptor sheet (30) having a dielectric support layer (36) and a heater layer (34) of microwave interactive material allowing passage of microwave energy as it is heated thereby, characterised in that a layer (130) of heat-conducting, microwave reflecting material is adhered to the heater layer of the susceptor sheet.

2. A composite stock according to claim 1 comprising a second layer (50b) of susceptor stock adhered to the layer of heat-conducting, microwave reflecting material of the composite stock.

3. A composite stock according to claim 2 in which the heater layer of the second layer (50b') of susceptor stock faces the layer of reflecting material.

4. A stock according to any preceding claim having a heater layer of which the surface resistivity is less than about 6 ohms/cm.

5. A stock according to claim 4 in which the heater layer has a surface resistivity of 5 to 6 ohms/cm.

6. A receptacle for cooking a food article in a microwave oven, comprising:

(a) an upper portion (52) of microwave susceptor stock having an outwardly facing dielectric layer (36) and an inwardly facing heater layer (34) of microwave interactive material allowing passage of microwave energy as it is heated thereby;

(b) a lower portion (50) for supporting the food article and having an inwardly-facing heater layer (34) of microwave interactive material;

(c) side walls (60), (62) securing the upper and lower portions in spaced relationship,

characterised in that the lower portion comprises a layer of composite sheet stock according to any one of claims 1 to 5 or at least one additional layer (50b) of microwave susceptor stock having a heater layer of microwave interactive material.

7. A receptacle according to claim 6 in which the heater layer of the additional layer(s) of susceptor stock has a surface resistivity lower than the surface resistivity of the inwardly facing heater layer of the lower portion.

8. A receptacle according to claim 6 or claim 7 in which the heater layer of the additional layer(s) of susceptor stock is inwardly facing.

9. A receptacle according to any one of claims 6 to 8 comprising two additional layers of microwave susceptor stock adjacent to the lower portion.

10. A receptacle according to any one of claims 6 to 9 including means for holding the lower portion of the receptacle in a position spaced vertically from the floor or lower wall of a microwave oven.

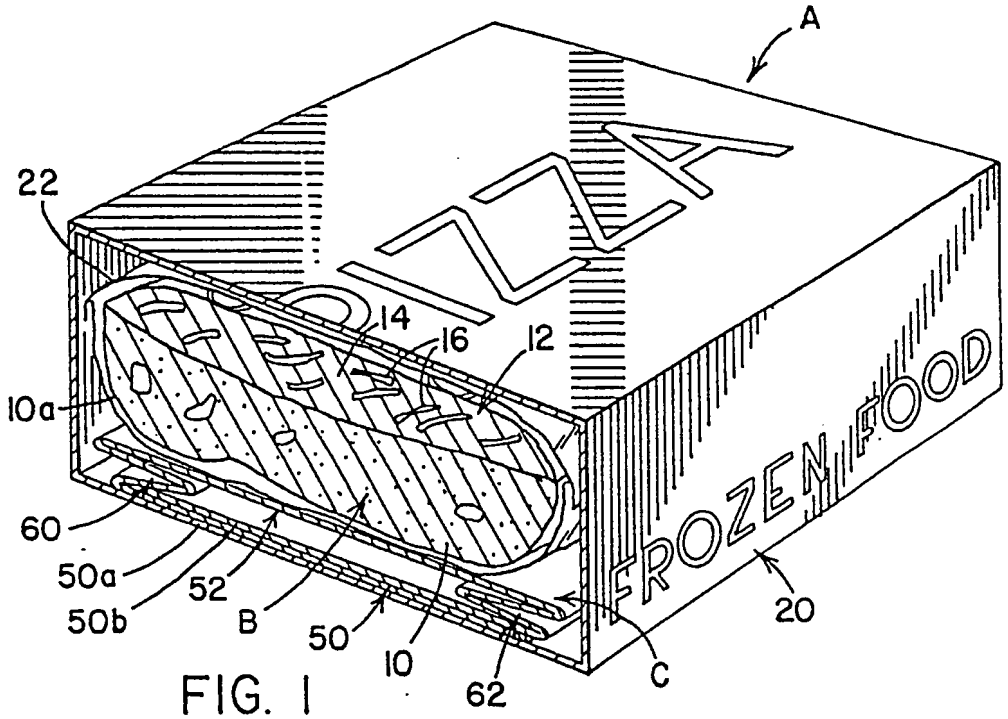
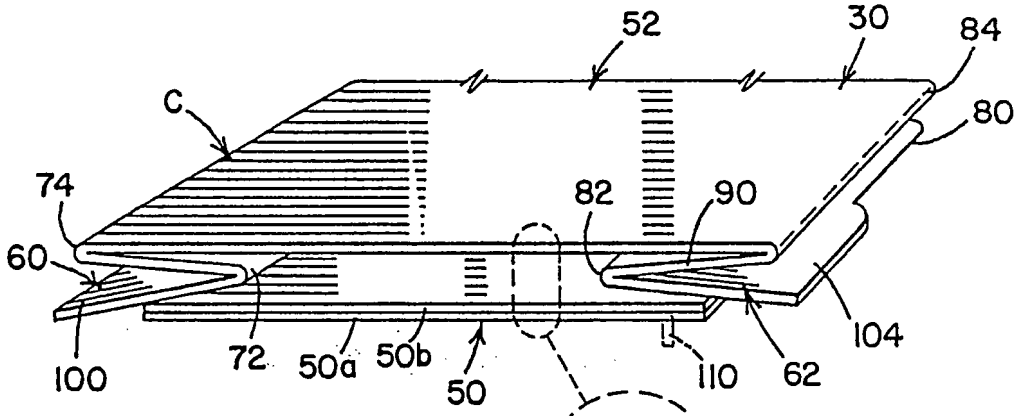

A
22
14
16
12
10a
60
50a
52
50b
B
50
10
62
C
20
FROZEN FOOD

FIG. 1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C
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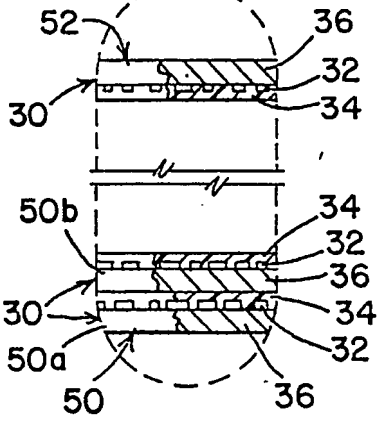
82
90
60
100
72
50a
50b
50
110
62
104

FIG. 2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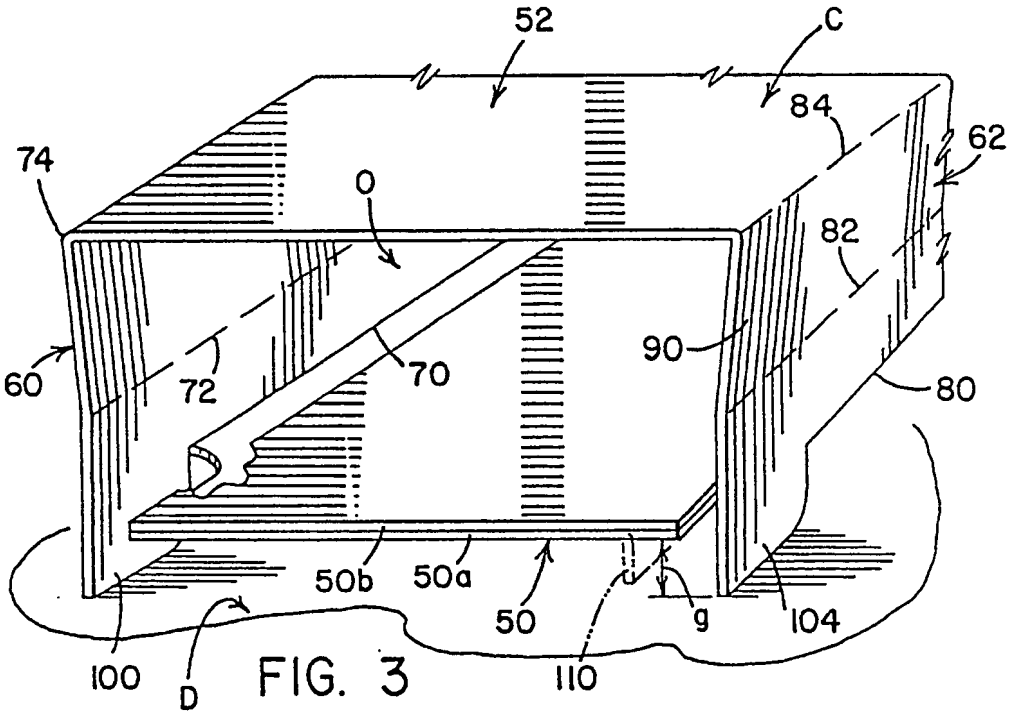
50
36


52
C
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D
110

FIG. 3

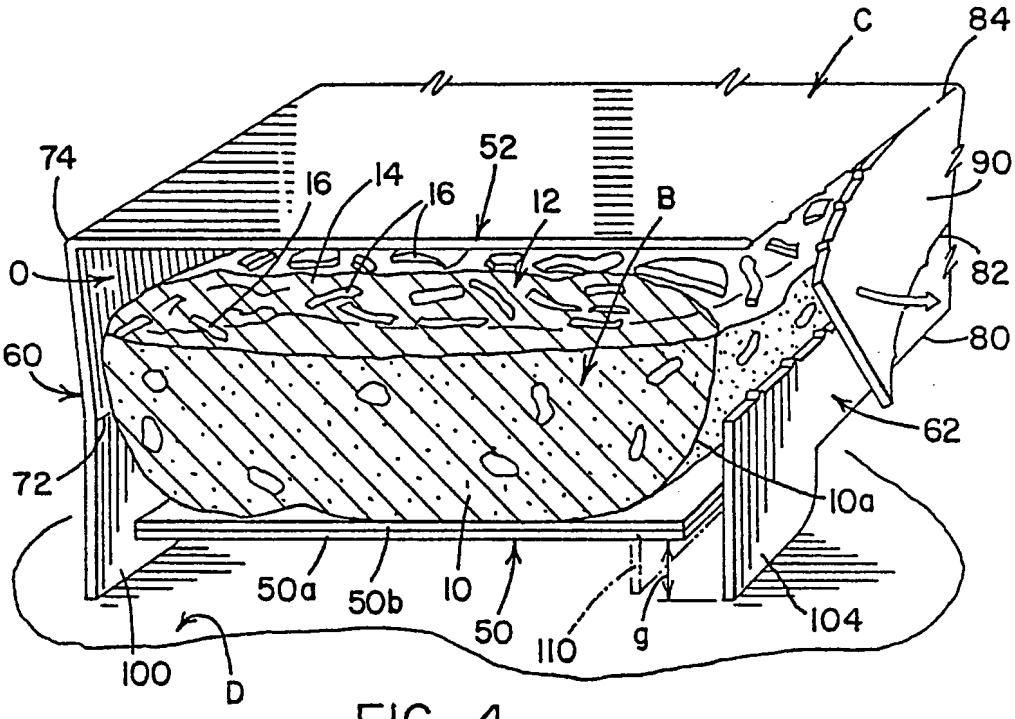
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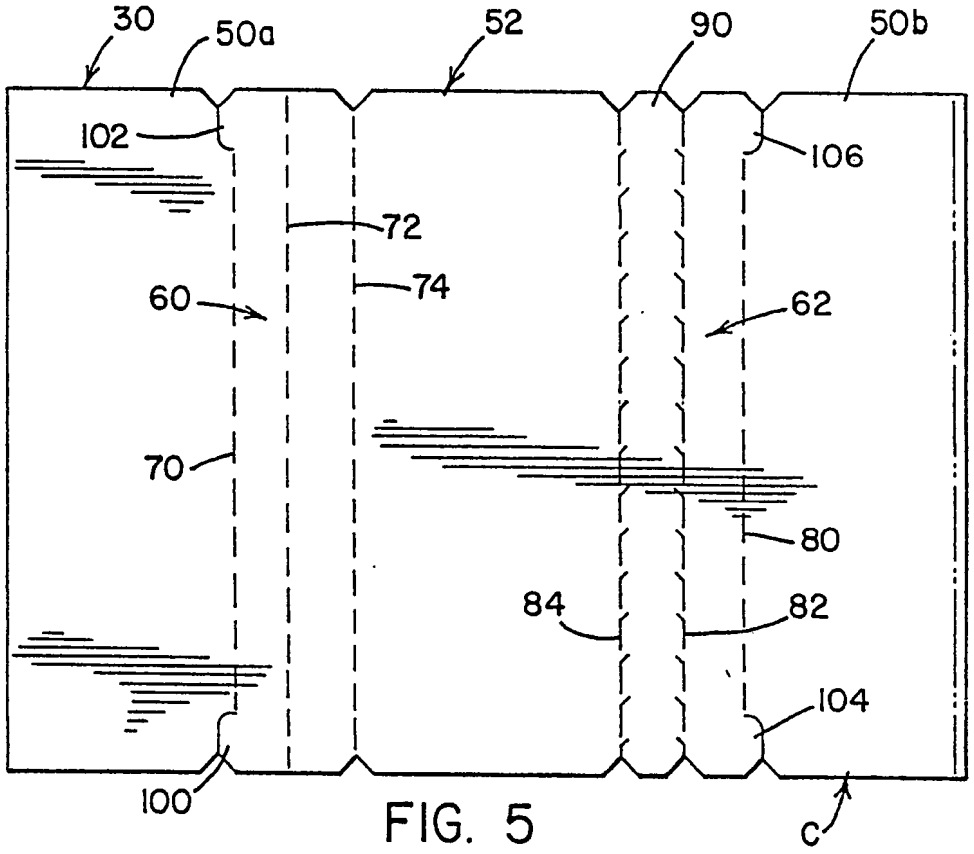
FIG. 4


30
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C

FIG. 5

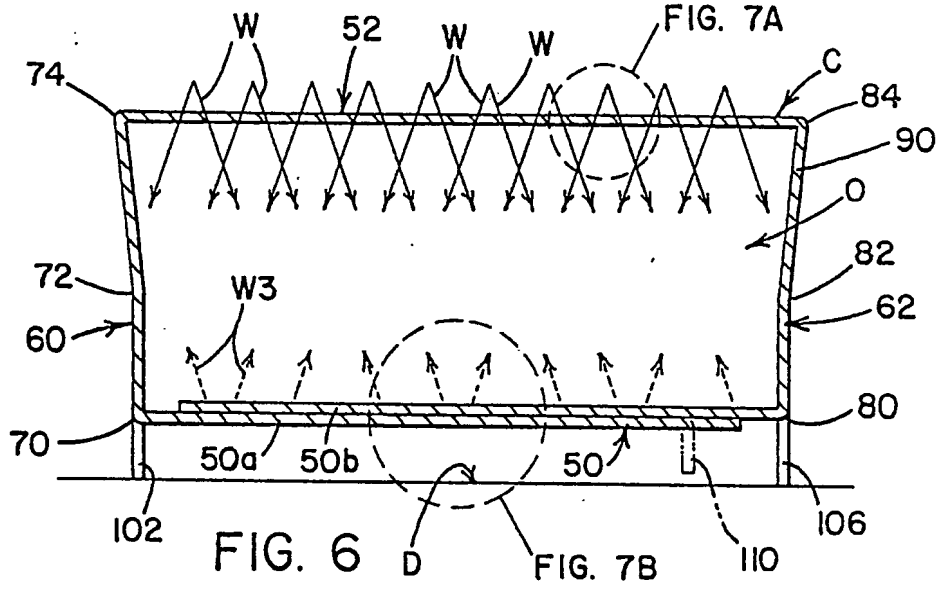

W
52
W
W
FIG. 7A
74
C
84
90
O
72
W3
82
60
62
70
80
50a
50b
50
102
D
FIG. 7B
110
106

FIG. 6

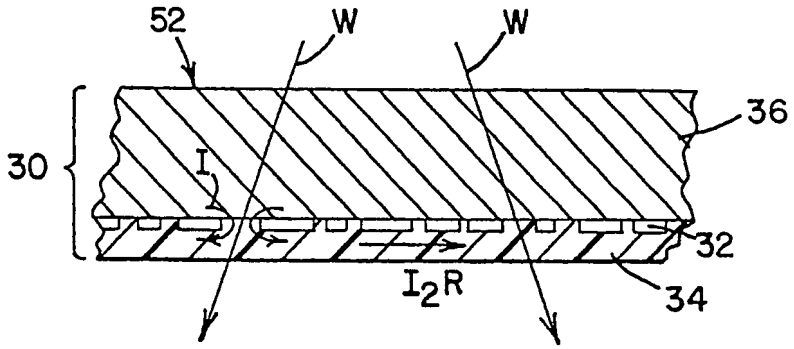


FIG. 7A

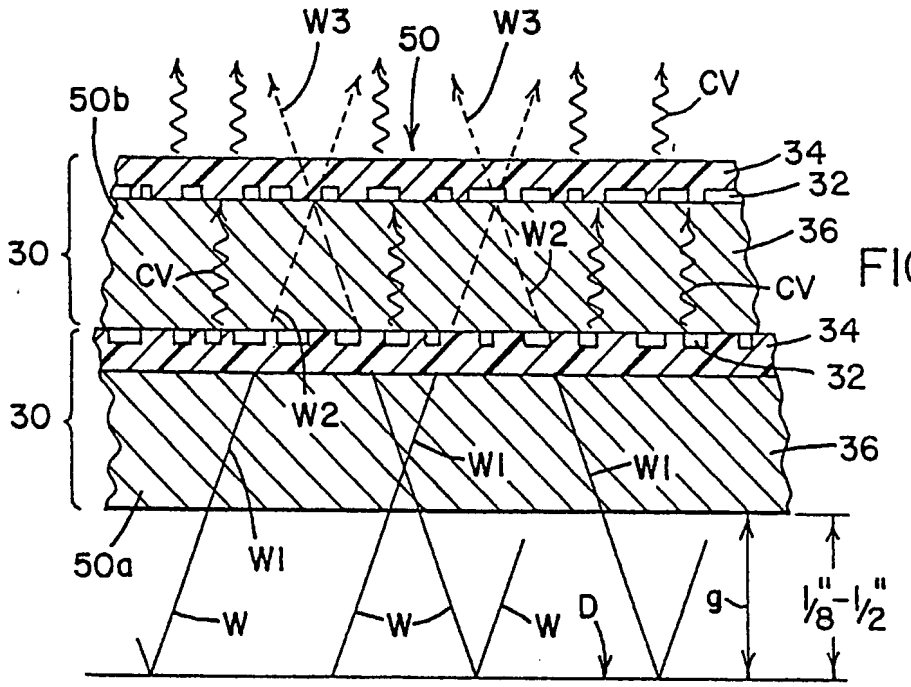


FIG. 7B

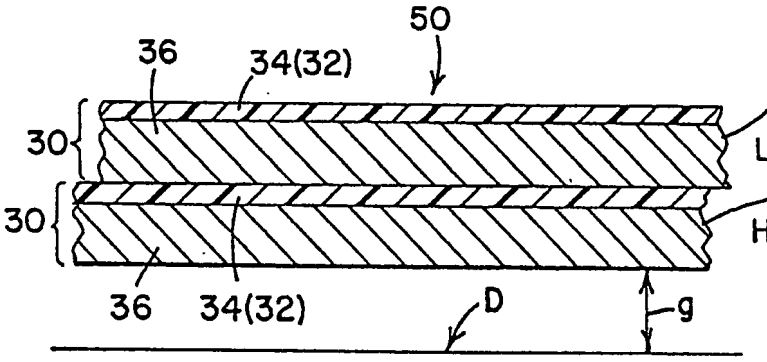


FIG. 8

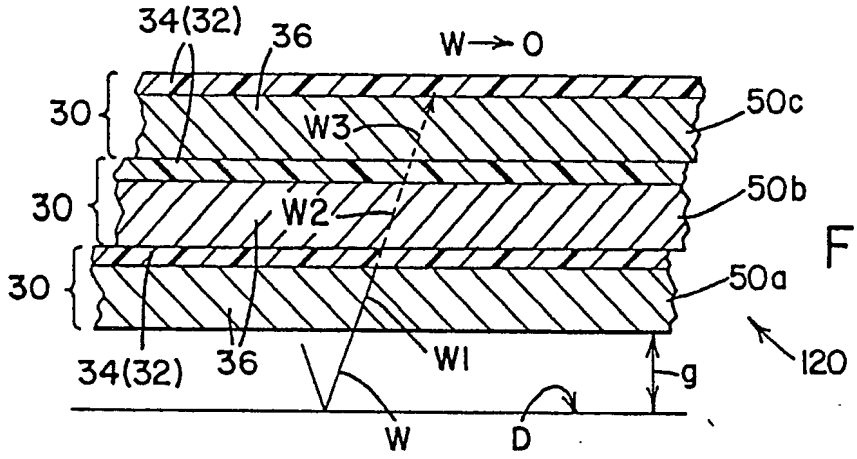


FIG. 9

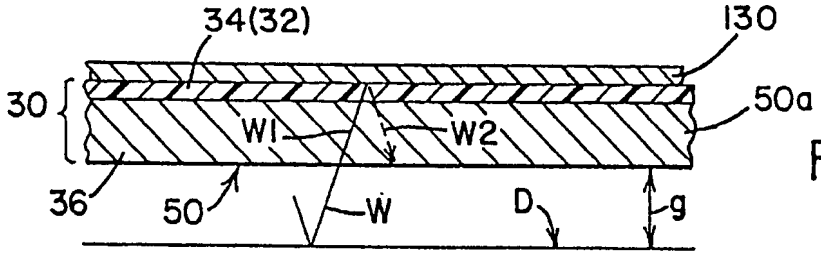


FIG. 10

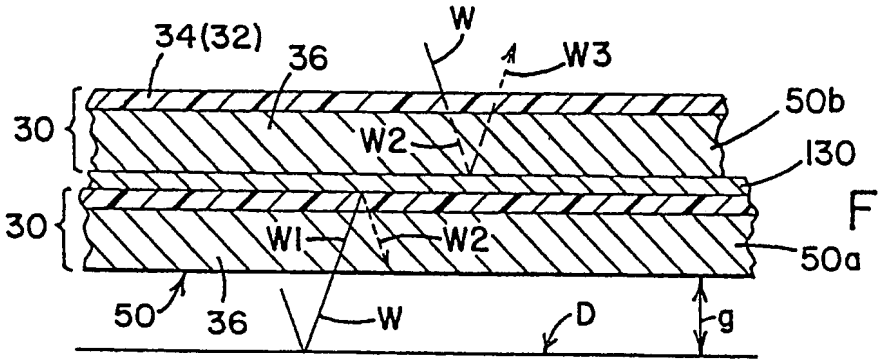


FIG. 11

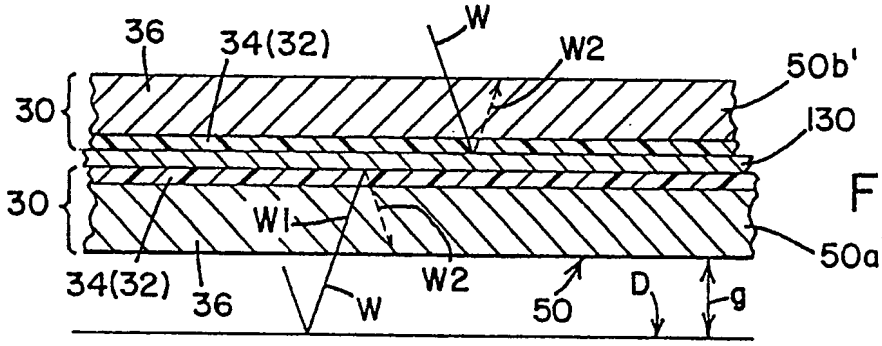


FIG. 12

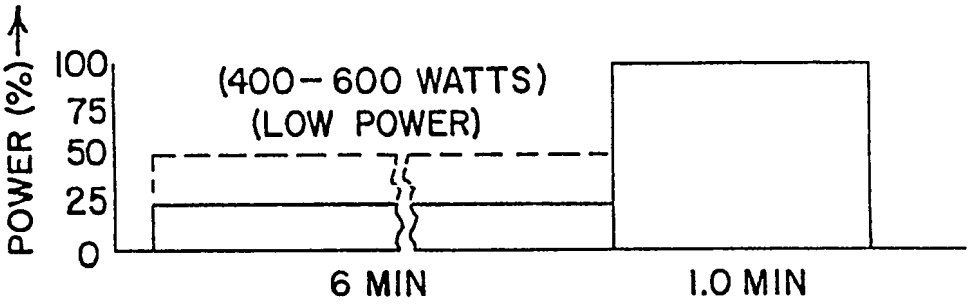


FIG. 13 (700 WATT OVEN)

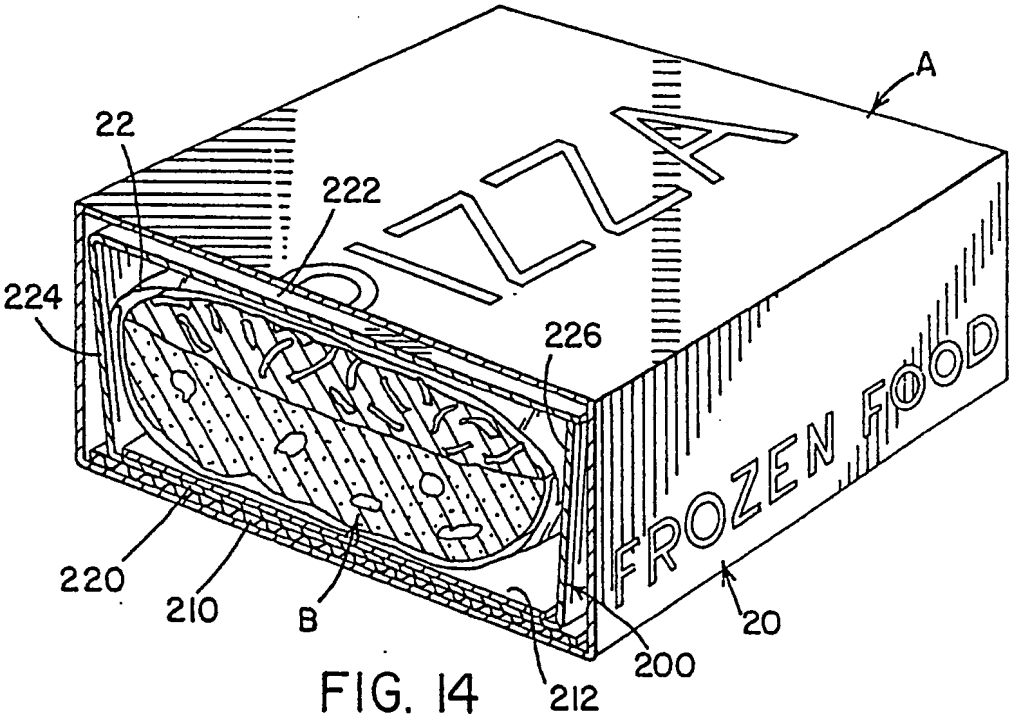

A
22
222
224
226
220
210
B
200
20
212
FROZEN FOOD

FIG. 14

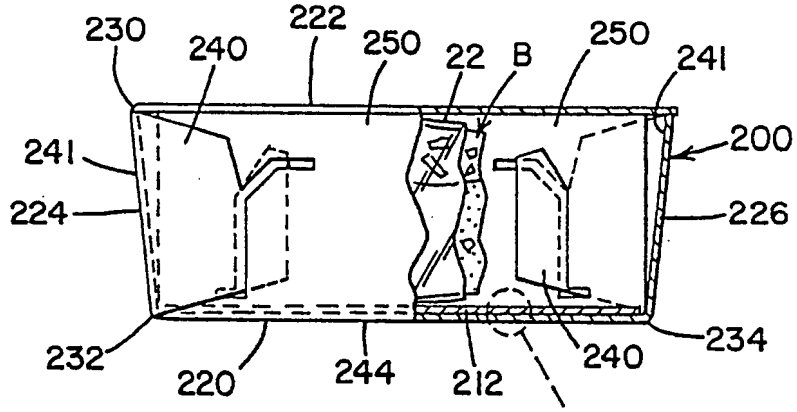
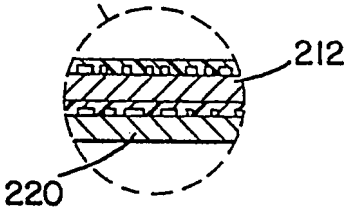

230
240
222
250
22
B
250
241
241
200
224
226
232
220
244
212
240
234

FIG. 15


212
220

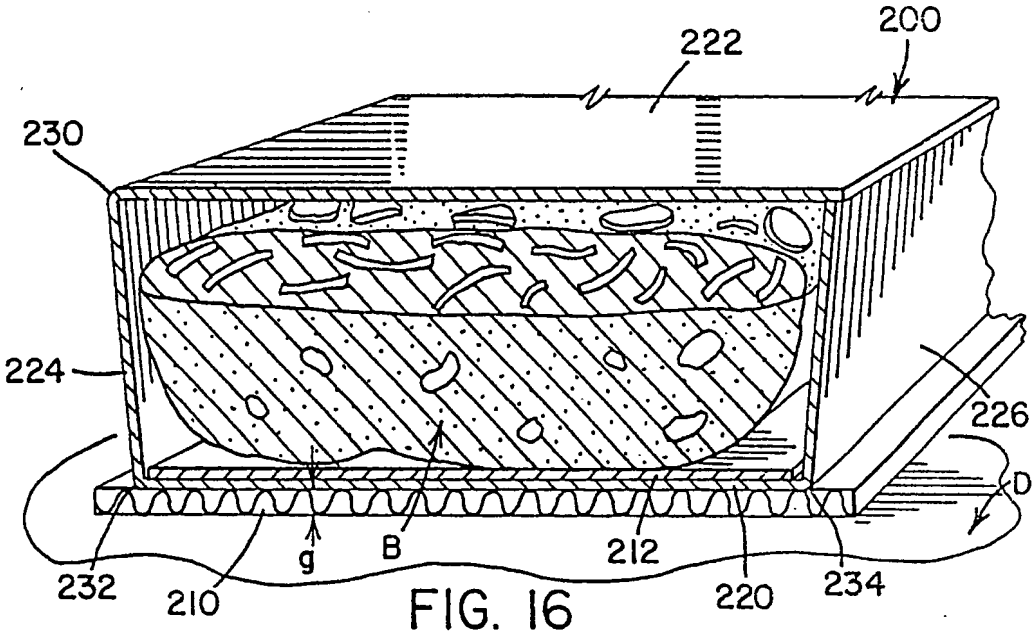

200
222
230
224
226
D
232
210
g
B
212
220
234

FIG. 16

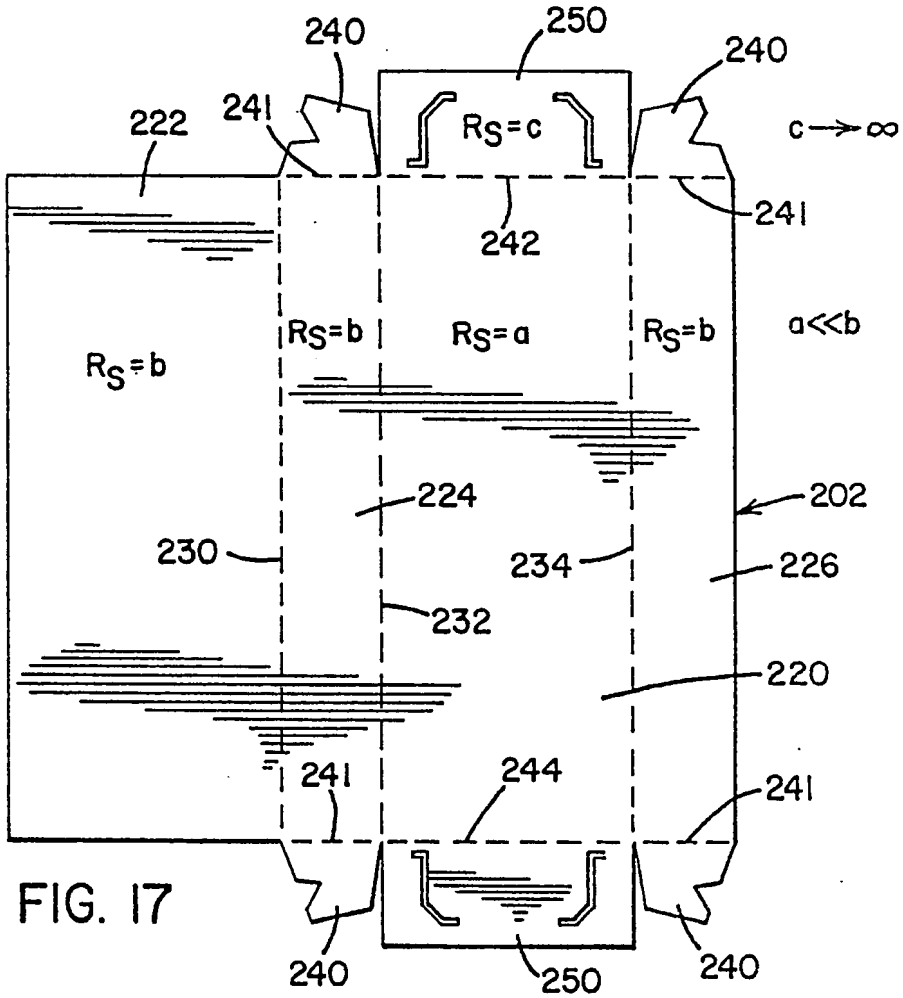

240
250
240
241
222
$R_S=c$
$c\to\infty$
241
242
$R_S=b$
$R_S=a$
$R_S=b$
$R_S=b$
$a\ll b$
224
202
230
234
226
232
220
241
244
241
240
250
240

FIG. 17